

Decision-Support Tool for Prevention and Control of Rift Valley Fever Epizootics in the Greater Horn of Africa

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Abstract: In East Africa, Rift Valley fever (RVF) usually occurs as explosive epizootics with prolonged inter-epidemic periods on the order of 8 to 10 years. The episodic nature of the disease and the rapid evolution of outbreaks create special challenges for its mitigation and control. Following the events of the 2006 and 2007 RVF outbreak in East Africa, decision-makers assembled their collective experiences in the form of a risk-based decision support tool to help guide responses in future emergencies. The premise of the tool is that a series of natural events are indicative of the increasing risk of an outbreak and that actions should be matched to this evolving risk profile. In this manner, investment in prevention and control can be qualitatively optimized. The decision support tool is a living document written through stakeholder input. This publication captures the current tool as an example of risk-based decision support.

INTRODUCTION

Following the 2006/07 Rift Valley fever (RVF) epizootic in East Africa, a participatory assessment carried out jointly by the International Livestock Research Institute (ILRI) and the Government of Kenya Department of Veterinary Services (GoK DVS) concluded that “*The severity of the...RVF epidemic in northern Kenya was exacerbated by delays in recognizing risk factors...and in taking decisions to prevent and control the disease.*” Furthermore, it noted that “*Kenya lacks a well-documented contingency/emergency plan for RVF.*” Among factors that limited the response to the outbreak, the assessment highlighted the “*lack of pre-allocated emergency funds, particularly within the livestock sector,*” which greatly delayed responses (ILRI 2008).

Because of the episodic nature of RVF, with outbreaks occurring on average at intervals of around a decade but sometimes twice as long, to deal with the disease is especially challenging. In the intervals between outbreaks, there is a tendency for veterinary departments’ institutional memories to be lost: the people who fought the last outbreak are very often no longer in post for the next.

To address these issues and concerns, a joint Food and Agriculture Organization of the United Nations (FAO)/ILRI workshop was held in March 2008. Participants, drawn from the Kenya and Tanzania Departments of Veterinary Services, FAO, ILRI, United States Centers for Disease Control (CDC), African Union-Interafrican Bureau for Animal Resources (AU-IBAR), and two veterinary NGOs, Vétérinaires Sans Frontières (VSF) Suisse and VETAID, worked through a three-stage process, which in turn:

1. Identified the sequence of events related to increasing and decreasing RVF epizootic risk in the Greater Horn of Africa (GHA).
2. Compiled an inventory of interventions that can be used to prevent or control an RVF epizootic in the GHA.
3. Matched actions selected from the inventory to specific stages of the sequence of events related to RVF epizootic risk.

This decision-support tool draws on the ILRI/GoK DVS participatory assessment (ILRI 2008), the joint FAO/ILRI workshop, and other relevant sources. It is targeted at directors of veterinary services in the countries of the Greater Horn and is intended to provide clear, practical guidance as to what are appropriate and

inappropriate responses at the various stages of the RVF epizootic cycle. It is intended that the tool will facilitate the directors to take timely, evidence-based decisions to prevent and control RVF epizootics, thereby significantly reducing the scale of impacts of the disease on lives, livelihoods, and local, national, and regional economies. Although targeted primarily at directors of veterinary services, it recognizes that close collaboration between the veterinary and public health sectors are essential for the effective prevention and control of zoonoses, including RVF.

Assumptions. A number of assumptions have been made in the development of the decision-support tool. Unless these basic, first steps have been taken, implementation of a detailed action plan is unlikely to be possible. These are:

- A national RVF emergency fund has been established and procedures and modalities put in place to enable the fund to be made available rapidly in response to predetermined criteria.
- An effective communication system has been established including a clear chain of command from the director of veterinary services to the field, which facilitates early and effective communication back up to the chain from field to the director, and effective communication between the veterinary department and other relevant ministries and departments, such as health, planning, finance, and provincial administration.
- The above are captured in a government-approved RVF Contingency Plan.
- During the normal situation between outbreaks, users of the tool will review the suggested activities for each stage in conjunction with their Contingency Plan. This will allow them to cost the activities and ensure the necessary budget will be available either from the emergency fund, core VERSUS budget or in timely requests to donors.

The decision-support tool. This decision-support tool consists of four elements:

1. A map of areas in the GHA at risk from RVF epizootics.
2. A list of the sequence of events related to increasing and decreasing risk of an RVF epizootic in the GHA.
3. Actions matched to the sequence of events listed in 2, above.
4. Selected information, resources, and references.

A note on the use of vaccines for RVF. Vaccination against RVF in the Greater Horn of Africa presents a number of challenges. Indeed, some experts consider that these are so great that they effectively preclude the use of vaccines to prevent/control RVF outbreaks in this region—although they are effectively used in other regions where the epidemiology

*The names of these individuals are listed at the end of this paper.

of the disease, environmental conditions, and infrastructure are different, e.g., southern Africa.

The currently available Smithburn vaccine has a shelf-life of around 4 years, while the interval between outbreaks in the Greater Horn tends to be around 10 years, although it has been closer to 20 years during some inter-epizootic periods. Hard pressed veterinary authorities with many demands on their scarce resources are understandably reluctant to maintain vaccine stocks for a disease, which occurs intermittently and are likely to expire before they are used. For sound commercial reasons the manufacturers also avoid maintaining large stocks, which are likely to reach their expiry dates before they can be sold. However, the lead time needed by manufacturers to produce new batches of vaccine can be several months. Waiting until an RVF outbreak is highly likely or actually occurring will leave too little time for the manufacturers to respond. Even if the manufacturers did have adequate vaccine stocks, waiting until the heavy rains and flooding have begun means that it is very difficult, often impossible, to transport and distribute vaccine in remote areas that often have no all-weather roads.

One possible way forward is for a regional organization and/or donor(s) to fund a strategic regional vaccine stock, which could be rapidly deployed in times of need. This would remove the burden from national veterinary authorities to maintain costly vaccine stocks. One option would be for the vaccine manufacturer to be paid to maintain a minimum stock of vaccine (likely to be tens of millions of doses) at all times. Modeling future requirements for vaccines could be a useful approach to help predict the size of the strategic stock required.

In the longer term, new and improved vaccines, for example ones that have longer shelf-lives, may be developed that help overcome this problem, or earlier early warning systems may be developed that provide manufacturers with the lead time they require. Meanwhile, veterinary authorities need to develop clear policies and guidelines for vaccination against RVF and to have these in place before the next RVF outbreak. This will entail balancing the cost of vaccination, including maintaining strategic stocks, against the periodic risk of an outbreak and the associated threat to lives, livelihoods, and national economies.

In determining if and how to use vaccination to prevent or control a forecasted outbreak of RVF, this decision-support tool encourages an understanding of outbreak risk, the identification of zones at highest risk, a realistic estimation of delays caused by logistical constraints, and planning for the time needed for vaccinated animals to develop a protective immune response, i.e., 5–7 days with the Smithburn vaccine, after which protection is long lasting (Geering and Davies 2002). Triangulation of this information will help directors of veterinary services to decide if vaccine should be used, and will allow for the targeting of vaccine stocks to high-risk areas in sufficient time to build sufficient herd immunity before the potential outbreak. For example, the joint ILRI/GoK DVS participatory assessment of the 2006/7 RVF outbreak (ILRI 2008) found that, although an FAO EMPRES early warning was issued in November, the earliest cases in livestock occurred in mid-October in North Eastern Province. This means that vaccination campaigns would have had to have been completed by the end of September to allow sufficient time for herd immunity to develop to prevent initial outbreaks. However, these early outbreak areas had already been subject to heavy rains by mid-September that made them inaccessible, pushing the need to have completed the vaccination campaigns to early-September.

Time between each pair of outcomes (days)	Outcome
141	Total days lapsed before herd immunity achieved
7	Target livestock population immune
20	Completion of vaccination campaign
7	Start of vaccination campaign in targeted high-risk area: 1000,000 animals, 2 vaccination teams each of 5 persons; 2,500 animals vaccinated per day per team
7	Movement of vaccine from central store to high-risk area
3	Vaccine delivery and stock management at central level
90	Shipment of vaccine
7	Manufacturer receives order and starts vaccine production
	Vaccine ordered

The following table shows an example of the delay between ordering vaccine (at foot of table) until herd immunity is achieved (at top of table): the exact period will vary based on local circumstances but in this example is 141 days.

Element 1: RVF epizootic risk map. This decision-support tool is intended for use primarily within areas of the Greater Horn that are at risk from epizootics of RVF. These are shown in green on Map 1 (Figure 1). Within these mapped zones are smaller areas of highest risk for early outbreaks that can be identified by departments of veterinary services based on known risk factors such as vector habitat, susceptibility to floods, soil types, dambos, and time of involvement in previous outbreaks.

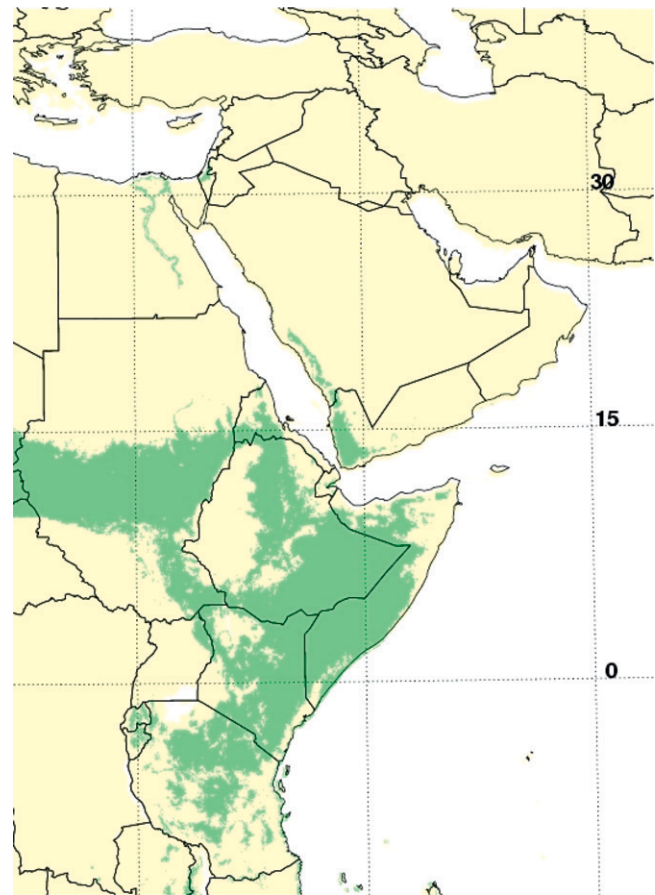


FIGURE 1. Element 1: Map 1: Areas at risk of Rift Valley fever (RVF) epizootics in the Greater Horn of Africa (shaded green). Credit: Assaf Anyamba and DoD-GEIS & NASA Goddard Space Flight Center Rift Valley Fever Monitoring Team.

Element 2: Sequence of events related to increasing and decreasing risk of an RVF epizootic in the Greater Horn.

The following list describes the sequence of events that characterizes the progressive increase and eventual decrease in risk of an RVF epizootic in the Greater Horn—from the normal situation between epizootics, through the height of an epizootic with confirmed cases in both livestock and people, and the eventual return to normality.

This sequence is only relevant in or close to areas within the Greater Horn where there is a known history of RVF epizootics: beyond the Horn, e.g., in West Africa, the epidemiology of the disease is different; within the Horn there are areas where some of these events could occur, e.g., heavy rain and flooding, but where there is no known history or risk of RVF epizootics. Therefore, decision-makers should take into consideration areas at risk as shown by Map 1 (Figure 1), the RVF outbreak history in a specific area, and the RVF event sequence stage when deciding on an action.

The Sequence of events related to increasing and decreasing risk of an RVF epizootic in the Greater Horn of Africa are:

1. Normal situation between outbreaks*
2. Early warning of RVF issued (such as GEIS†) and/or early warning of heavy rain by national meteorological departments
3. Localized, prolonged heavy rains reported by eye-witnesses
4. Localized flooding reported by eye-witnesses
5. Localized mosquito swarms reported by eye-witnesses
6. First detection of suspected RVF in livestock by active searching and/or rumors from herders
7. Laboratory confirmation of RVF cases in livestock
8. First rumor or field report of human RVF case
9. Laboratory confirmation of first human RVF case

*During inter-epizootic interval there will be low-level virus activity in at-risk areas. Although this may occasionally result in RVF cases in livestock, usually these will be mild – often asymptomatic.

†U.S. Department for Defense Global Emerging Infections Surveillance and Response System (GEIS). Available at: <http://www.geis.fhp.osd.mil/GEIS/SurveillanceActivities/RVFWeb/infolpages/updateRVF.asp>.

10. No new human cases for 6 months
11. No clinical livestock cases for 6 months
12. Post-outbreak recovery and reflection
 1. Normal situation between outbreaks (i.e., same as event 1)

It is recognized that animal health decision-makers are worried about taking action to prevent or declare an RVF outbreak: if they act too soon, they risk wasting resources when there was no real risk of an RVF epizootic; if they delay waiting until an epizootic has begun then it is likely to be too late to mount an effective preventive campaign. However, the risk of taking action against RVF does not need to be managed as an all or nothing event. This tool is designed to help decision-makers lower the risk to themselves, their governments, and citizens by taking action commensurate with the level of risk at the right time. As the sequence of events (see above) progresses from event 1 to 7, the probability that an RVF epizootic will occur increases; the justification for taking actions to mitigate the risk also increases, and the risk of taking unjustified actions decreases. For events 2–4, although the risk of an RVF epizootic is progressively increasing it is not certain that an epizootic will occur. *From event 5 onward, it should be assumed that an RVF epizootic will or has occurred.*

Element 3: Actions matched to events in the RVF sequence. The following tables match specific actions to each of the stages in the RVF epizootic sequence.

The types of interventions are presented under one of 12 major categories:

- Capacity building and training
- Communication
- Coordination
- Early warning systems
- Surveillance
- Disease control
- Vector control
- Trade and markets
- Funding
- Post-outbreak recovery and reflection
- Institutions and policies
- Research, impact assessment and risk assessment

TABLE 1
Normal situation between outbreaks

Category	Activity	Explanation
Capacity	Risk assessment	Risk assessment capacity developed/maintained in national veterinary services and universities and available to be applied to RVF contingency planning and response Undertake risk assessment along main livestock supply chains (focusing on pastoral areas) RVF contingency plan kept under review and updated as necessary.
	Laboratory diagnosis	Training of personnel and upgrading of diagnostic laboratories to be able to rapidly diagnose RVF, for livestock using OIE-recognized standards.
	Information management system	Develop a disease information management system to ensure effective compilation and dissemination of information at all levels Develop a marketing information system to monitor livestock market behaviors (number and qualities of animals, species compositions, actors involved) and animal movements along main supply chains.
	Simulation exercise	Hold periodic simulation exercises to test response to RVF epizootic and to ensure veterinary, medical, and entomological sectors can work effectively together.
Communication	Communication system appraisal	Identification of target audiences Assessment of the communication needs Formulation of communication strategy.
	Participatory message development	Development of appropriate messages Identify the best method(s) of reaching different segments of the population at risk Pre-testing of messages.
	Engagement with local media, especially science journalists	Establish links with local science journalists to make them aware of RVF and bring to their attention any relevant developments.

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TABLE 1
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Category	Activity	Explanation
Coordination	Coordination with national medical authorities, neighboring country veterinary authorities, regional and international organizations with interest in RVF	Maintain updated contact information for appropriate officers/departments in national, neighboring country, regional and international organizations Promote and mainstream a “One Health” approach to prevention and control of RVF and other zoonoses through regular communication with counterparts in Ministry of Health and other relevant ministries Hold periodic meetings between regional CVOs Explore potential role of bodies such as FAO’s ECTAD, AU-IBAR, or EAC in ensuring regional harmonization and cooperation Consider combining coordination of RVF with other emerging and re-emerging zoonoses Establish and draw up operating procedures for multi-sectoral committee under chair of RVF to take control in event of RVF outbreak Define communication channels between bordering countries along the main supply chains.
Early warning	International RVF early warning systems	Keep a watching brief of international RVF early warning systems and maintain subscriptions to e-mail RVF early warning alerts Maintain access to internet/ e-mail services.
	Rumor logs	Maintain system of monitoring and investigating rumors of localized heavy rains, flooding, mosquito blooms, and RVF events from field Ensure veterinary department “hot-line” phone numbers remain operational and are widely known within at-risk areas Maintain a system of monitoring and investigating information about changes on market behaviors and trends (quality and number of animals, species composition, actors composition) at main livestock markets.
Surveillance	Participatory disease surveillance (PDS)	PDS capacity developed and active in national veterinary services and universities for national and farmer-priority diseases Engage with CAHWs and incorporate them into formal surveillance systems Update and make available disease lexicons in local languages.
	Mosquito surveillance	Establish system for routine surveillance of mosquito populations in at-risk areas combining trapping with community reports Map where RVF vectors are present.
	Animal movement Sentinel herds	Continue routine monitoring of animal movement along the main supply chains. Establish in high-risk areas and take baseline samples: sentinel herds are useful for retrospective analyses but, because of lag in receiving results, are not an early warning tool.
	Passive surveillance	Establish/maintain passive surveillance systems, including monthly disease reports from district veterinary officers and disease reporting by private animal health professionals.
	Surveillance for other diseases	Where possible combine routine surveillance for RVF with that for other zoonoses.
Disease control	Vaccination	Develop a clear policy on vaccination against RVF, including during inter-epizootic periods, when risk of RVF outbreak is high and in face of outbreak Consider routine vaccination, for example on a cost-recovery basis, geographically limited to those areas shown to be consistently first affected in an RVF epizootic Consider combining RVF vaccination with coverage of other priority diseases Maintain updated contact information with RVF vaccine manufacturers Maintain watching brief on development and availability of new and improved vaccines Maintain disease control equipment in ready-to-use state.
Vector control	Control of endemic RVF cases	Consider routine annual vaccinations at subsidized rates.
	Contracts for vector control services	Identify potential suppliers of vector control services, such as aerial spraying contractors, and develop outline agreements Maintain vector control equipment in ready-to-use state.
Trade	Dialogue with regional and international trading partners	Establish “rules of the game” with trading partners Maintain dialogue with trading partners to ensure they are aware of current RVF risk status and are aware of and support RVF contingency plan Institutionalize regional mechanisms to coordinate and harmonize disease control, certification, and trade across borders.
	Livestock supply chains Actors	Identify main livestock supply chains and actors involved. Engage actors along the supply chain to monitor and report animal movements (origin and destination) along the main supply chains and main livestock markets.
	Insurance	Identify possible mechanisms (insurance, contingency funds) to compensate traders from losses caused by trade restrictions.
Funding	Advocacy for increased budget to ministry responsible for livestock	Ensure adequate funds will be available when risk of RVF epizootic increases Advocacy to enhance capacity of trader associations, especially in monitoring and reporting animal movements and market behavior.
	Concept notes	Pre-prepare concept notes to request funds for donor-funded RVF interventions in event of epizootic.
Recovery	Not applicable at this stage	

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TABLE 1
Continued

Category	Activity	Explanation
Institutions and policies	National regulations and laws	Review nations regulations and laws and ensure that they are in alignment with RVF contingency plans.
	RVF diagnostic reagents	Lobby for free availability of RVF diagnostic reagents, such as by making them available through commercial channels.
	OIE guidelines	Keep abreast of OIE guidelines with regard to RVF prevention and control,* and implications for regional and international trade in livestock and livestock products.
	Commodity-based trade	Keep abreast of regulatory development regarding commodity-based trade and consider diversifying into commodity-based trade to avoid risky over-reliance on live animal trade to Arabian Peninsula countries.
	Regional Coordination	Institutionalize regional mechanism to coordinate and harmonize disease control, certification, and trade across borders.
Research, impact assessment and risk assessment	RVF prevention and control technologies and approaches	Keep abreast of advances in RVF prevention and control technologies and approaches, and feed into RVF contingency planning process as appropriate Undertake cost-efficacy studies of RVF prevention and control options and feed results into contingency plans; also make results available to livestock producers and traders.

* See http://www.oie.int/eng/normes/mcode/en_chapitre_2.2.14.htm for OIE's recommendations regarding import of livestock and livestock products from infected countries with or without disease.

TABLE 2
Early warning of RVF issued (such as GEIS) and/or early warning of heavy rain by national meteorological departments

Category	Activity	Explanation
Capacity	Assessment	Rapid verification of availability and functionality of capacity in critical areas, including coordination (regional, national RVF committee), disease control (veterinary service and private personnel), and surveillance (laboratory, PDS, district veterinary officers) Rapid verification of availability and functionality of capacity in critical areas, including coordination market information system and animal movement along the supply chain.
Communication	Public awareness	Warn communities in at-risk areas to be on lookout for and report to relevant authorities heavy rainfall, flooding, mosquito swarms, RVF cases Warn trader associations in at risk areas to be on the lookout for abnormal market behavior (movement, species composition, quantity and quality of animals, and actors).
Coordination	Multi-sectoral technical committee under chair of DVS	RVF multi-sectoral committee to activate emergency preparedness procedures Collaboration between DVS and trader association Activate cross-border coordination mechanisms between DVSs and traders associations.
	Collaboration between human health and veterinary sectors	Need to ensure good collaboration, communication, and coordination between health and veterinary sectors.
	Joint activities	Seek opportunities for joint activities between sectors, for example joint surveillance activities with veterinarians and entomologists.
Early warning	International RVF early warning systems	Maintain active monitoring of RVF early warning websites and e-mail alerts to keep abreast of epizootic risk escalation Communicate with international, regional, and national expert focal points to fully understand early warning and its implication.
	National meteorological data	Set up system for weekly rainfall data and interpretation to be supplied to DVS by national meteorological service.
Surveillance	Local ground truthing	Activate local networks for monitoring of local conditions including rumor log.
	Active surveillance	Teams carry out active surveillance for heavy rainfall and flooding targeted at areas with past history of RVF and areas highlighted by early warning systems.
Disease control	Sentinel herds	Ensure routine serological and symptomatic monitoring of sentinel herds to detect RVF virus.
	Diagnostic laboratories	Notify national/regional veterinary diagnostic laboratories of RVF risk status.
	Vaccination	Notify vaccine manufacturer of RVF risk status and check available vaccine stocks Order vaccine stocks Limited vaccination using existing stock in target areas shown to be consistently first affected in an RVF epizootic Private veterinarians could offer RVF vaccination on a fee paying basis; DVS could bring this opportunity to attention of private veterinarians and veterinary associations Take delivery of vaccine and pre-position in at-risk areas Vaccinate livestock in "hot spots" using Smithburn vaccine, particularly those hot spots that will become non-accessible when rains start.
Vector control	Environmental control	Notify manufacturers of RVF risk status and check available insecticide stocks.
Trade	Insecticides applied to livestock	Notify manufacturers of RVF risk status and check available insecticide stocks.
	Notify trade partners	Be aware that trade partners will also receive international early warning notifications Notify regional/international trade partners that RVF contingency plan is being put into action.

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TABLE 2
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Category	Activity	Explanation
Funding	Notification of RVF early warning	Notify donors of RVF risk status and potential submission of application for funds should RVF epizootic stages progress Initiate process to access national RVF emergency funds.
Recovery	Not applicable at this stage	
Institutions and policies	Not applicable at this stage	
Research, impact assessment and risk assessment	Risk assessment	Conduct rapid risk assessment and inform decision and policy-makers.

TABLE 3
Localized heavy rains reported by eye-witnesses

Category	Activity	Explanation
Capacity	Notification	Notify coordination, surveillance, and disease control human resources of elevation in RVF risk level Notify trader association of elevation of RVF risk level.
Communication	Public awareness	Use RVF messages developed previously: information to general public; consumer messages; in at-risk areas provide public health information and encourage reporting of flooding, mosquito swarms, and suspected RVF cases.
Coordination	Multi-sectoral technical committee under chair of DVS	Oversee communication messages (ensure consistency between messages from livestock and public health sectors) Oversee mobilization of funds Oversee collaboration between ministries Oversee activities of NGOs, national and international institutions Oversee implementation of prevention and control strategy Oversee mobilization of trader association.
	Local RVF management committees	Local RVF multi-sectoral committee to activate emergency preparedness procedures Multi-sectoral supply chain committee activated, at national and cross-border levels To update traders associations and get feedback from local supply chains.
	DVS-DVO-DVS	DVOs proactively keep updated on preparations at HQ Issue reminders of policies and strategies to DVOs DVOs keep DVS updated on local situation.
	AU-IBAR/FAO/OIE Regional Animal Health Center	Coordinate vaccine supply among at-risk countries.
Early warning	International RVF early warning systems	Continue active monitoring of RVF early warning websites and e-mail alerts to keep abreast of epizootic risk escalation Communicate with international, regional, and national expert focal points to fully understand early warning and its implication.
	National meteorological data	Continue monitoring daily rainfall data and meteorological forecasts.
	Local ground truthing	Continue local networks for monitoring of local conditions Continue monitoring livestock markets fed by catchment areas affected by localized heavy rains and continue local networks across supply chains.
Surveillance	PDS	Activate PDS in at-risk areas.
	Active surveillance	Monitor local flooding and mosquito populations in at-risk areas.
	Sentinel herds	Continue routine monitoring of sentinel herds to detect RVF virus.
	Animal movements	Intensive monitoring of live animal movements along the main supply chains in areas affected by localized heavy rains.
	Diagnostic laboratories	Ensure national/regional veterinary diagnostic laboratories are ready to receive and prioritize processing of samples from field.
Disease control	Rumor logs	Maintain rumor logs and communications channels.
	Vaccination	Position vaccine stocks beyond highest priority at-risk areas to secondary level priority areas Vaccinate around "hot spots" using Smithburn vaccine, and in and around those areas receiving localized heavy rains that had not been previously vaccinated but are still accessible.
Vector control	Insecticide for application to livestock	Order insecticide Take delivery and pre-position in at-risk areas.
Trade	Notify trade partners	Notification of trade partners that vaccination has been implemented in high-risk areas. Remind trade partners of OIE policy regarding vaccination, and provide evidence of compliance that allows for continuation of trade.
	Notification	Notify trader association that localized control measures (vaccination, vector control, movement restrictions) have been implemented in catchment areas and/or along the supply chain.
Funding	Advocacy	Apply to donors for immediate funding based on increasing RVF epizootic risk for preventive and control operations.
	RVF emergency fund	Mobilize national RVF emergency funds for use by DVS Mobilize local level RVF emergency funds for use by DVO Mobilize resources to support trader associations in monitoring main livestock markets and supply chains.

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TABLE 3
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Category	Activity	Explanation
Recovery	RVF emergency funds/insurance	Activate compensation or insurance scheme for traders affected by movement restrictions.
Institutions and policies	Not applicable at this stage	
Research, impact assessment and risk assessment	Risk assessment	Review and update rapid risk assessment.
	Impact assessment	Mobilize impact assessment monitoring team for imminent deployment.

TABLE 4
Localized flooding reported by eye-witnesses

Category	Activity	Explanation
Capacity	Notification	Notify coordination, surveillance, and disease control human resources of elevation in risk level Notify trader associations and cross border committees (if localized flooding is across borders or in the vicinity of border areas).
Communication	Public awareness	Information on vaccination for livestock keepers in at-risk areas Information about protecting families and livestock in at-risk areas Encourage reporting of mosquito swarms and suspected RVF cases Inform trader associations on movement restrictions/bans and/or RVF control measures Encourage reporting of abnormal market behavior and animal movements along the supply chain.
Coordination	Multi-sectoral technical committee under chair of DVS	Oversee communication messages (ensure consistency of messages from livestock and public health sectors) Oversee mobilization of funds Oversee collaboration between ministries Oversee activities of NGOs Oversee implementation of control strategy Oversee collaboration with trader associations.
	DVS-DVO-DVS	Keep updated on preparations at HQ Issue reminders of policies and strategies to DVOs DVOs keep DVS updated on local situation.
	Local RVF management committees	Continuation Support active searching (flooding, mosquitoes, disease) and encourage community reporting to DVO Sustained public awareness.
	East African Community/IGAD and COMESA	Advocate for donor activation of emergency funds Coordinate trade issues within RECs.
	FAO-OIE-IBAR Regional Animal Health Center	Coordination of vaccine supply in at-risk countries Activate cross-border committees.
Early warning	International RVF early warning systems	Maintain active monitoring of RVF early warning websites and e-mail alerts Communicate with international, regional, and national expert focal points to fully understand early warning and its implication.
	National meteorological data	Continue monitoring daily rainfall data.
	Local ground truthing	Continue local networks for monitoring of local conditions Continue monitoring livestock markets fed by catchment areas affected by localized flooding and continue local networks across supply chains.
Surveillance	PDS	Continue PDS in at-risk and adjacent areas.
	Active surveillance	Localized active monitoring of meteorological and vector situations through PDS and community systems.
	Sentinel herds	Continue routine monitoring of sentinel herds to detect RVF virus including sero-surveillance.
	Animal movements	Intensive monitoring of live animal movements along the main supply chains in areas affected by localized flooding.
	Diagnostic laboratories	Ensure national/regional veterinary diagnostic laboratories have allocated time and space for RVF sample analysis.
Disease control	Rumor log	Maintain rumor log and communication channels.
	Vaccination	Extend vaccination coverage to livestock adjacent to high-risk areas Do not vaccinate in areas that are already experiencing mosquito blooms.
Vector control	Supportive treatment	Carry out in areas where vaccination has been eliminated as a strategy.
	Spray mosquito breeding sites	Spray flooded areas if feasible.
	Insecticides applied to livestock	Apply insecticide to livestock in flooded areas.
Trade	Notify trade partners	Notify trade partners that vaccination coverage has been extended. Remind trade partners of OIE policy regarding vaccination, and provide evidence of compliance that allows for continuation of trade.
	Notification	Notify trader association that localized control measures (vaccination, vector control, movement restrictions) have been implemented in catchment areas and/or along the supply chain affected by localized flooding.
Funding	Donors	Funds available and in use Include donors on multi-sectoral committees and emergency committees.
	Emergency RVF funds	Mobilize local level disaster funds for use by DVO Mobilize national disaster funds for use by DVS Mobilize resources to support trader associations in monitoring main livestock markets and supply chains.

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TABLE 4
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Category	Activity	Explanation
Recovery	RVF emergency funds/insurance	Activate compensation or insurance scheme for traders affected by movement restrictions.
Institutions and policies	Not applicable at this stage	
Research, impact assessment and risk assessment	Risk assessment	Review and update rapid risk assessment.

TABLE 5

Localized mosquito swarms reported by eye-witnesses and first detection of suspected RVF in livestock by active searching and/or rumors from herders*

Category	Activity	Explanation
Capacity	Mobilization Notification	Coordination, surveillance, and disease control human resources fully mobilized. Notify trader associations and cross border committees (if localized mosquito swarms or first detection of RVF is across border areas or in the vicinity of borders).
Communication	Public awareness	Information for livestock keepers on vaccination of livestock in at-risk areas Public/animal health information about protecting families and livestock in at-risk areas Encourage reporting of mosquito swarms and suspected RVF cases Information on RVF for general public, consumer awareness messages through posters, radios, provincial administration <i>barasas</i> , field days, etc. Inform trader associations on movement restrictions/bans and/or RVF control measures Encourage reporting of abnormal market behavior and animal movements along the supply chain.
Coordination	Multi-sectoral technical committee under chair of DVS DVS-DVO-DVS Local RVF management committees East African Community/IGAD/COMESA RAHC	Oversee communication messages (ensure consistency of messages from livestock and public health sectors) Oversee mobilization of funds Oversee collaboration between ministries Oversee activities of NGOs Oversee implementation of control strategy Oversee collaboration with trader associations. Keep updated on preparations at HQ Issue reminders of policies and strategies to DVOs DVOs keep DVS updated on local situation. Continuation Support active searching (flooding, mosquitoes, disease) and community reporting to DVO Implement prevention and control activities Sustained public awareness. Coordinate trade issues within RECs.
Early Warning	Local ground truthing	Coordination of vaccine supply in at-risk countries Activate cross border Committee. Continue local networks for monitoring of local conditions Continue monitoring livestock markets fed by catchment areas affected by mosquito swarms or first detection of RVF and continue local networks across supply chains.
Surveillance	PDS for early outbreak detection Active surveillance Sero-surveillance Animal movements Definitive laboratory diagnosis	<i>Mosquito swarms</i> : Expand coverage to include affected and adjacent areas <i>First detection of suspect case</i> : Expand to include affected area and adjacent districts. <i>Mosquito swarms</i> : Expand active monitoring of meteorological and vector situations through PDS and community systems to include affected and adjacent areas. Collect mosquito samples for analysis <i>First detection of suspect case</i> : Expand to include affected area and adjacent districts. <i>Mosquito swarms</i> : Begin randomized sero-surveillance in areas experiencing mosquito swarms <i>First detection of suspect case</i> : Expand to include adjacent areas. Intensive monitoring of live animal movements along the main supply chains in high risk. Virus isolation and identification in suspect cases Identification of mosquito species and virus isolation.
Disease control	Vaccination Supportive treatment Quarantine and movement control	Do not vaccinate in areas with mosquito swarms or suspect livestock cases Vaccination of livestock in adjoining areas should be considered if feasible. Carry out in areas where vaccination has been eliminated as a strategy. Prevent movement of animals from infected to disease-free areas to protect national livestock-derived foods market, but note that this is very unlikely to prevent spread of the outbreak.
Vector control	Insecticide impregnated nets Spray mosquito breeding sites Insecticides applied to livestock	More to reassure communities and minimize incidence of malaria: unlikely to have any impact on RVF transmission to people. Spray flooded areas if feasible. Apply insecticide to livestock in flooded areas if feasible.
Trade	Movement control and quarantine Notification	Preventing animals from high-risk areas entering export markets Prevent animals originating from high-risk areas entering the supply chain. Notify trader association that control measures (vaccination, vector control, movement restrictions/bans) have been implemented in high risk catchment areas and/or along the supply chain crossing high risk areas.
Funding	Emergency RVF fund	Activate funding for neighboring/adjacent high-risk areas.

Continued

TABLE 5
Continued

Category	Activity	Explanation
Recovery	RVF emergency funds/ insurance	Activate compensation or insurance scheme for traders affected by movement restrictions.
Institutions and policies	Not applicable at this stage	
Research, impact assessment and risk assessment	Proper record keeping	To enable lessons to be learned to improve future prevention and control responses.

*The activities for these two events are mostly similar and so have been combined, but note that different activities are listed for each under the **Surveillance** heading

TABLE 6

Laboratory confirmation of RVF cases in livestock and first rumor or field report of human RVF case and first confirmed human case*

Category	Activity	Explanation
Capacity	Mobilized	Capacity at all levels mobilized Capacity of trader mobilized to reduce exposure of live animals to RVF infection.
Communication	Public awareness	Information for livestock keepers on vaccination of livestock in at-risk areas Information in affected areas about sanitary slaughter Public/animal health information about protecting families and livestock in at-risk areas Encourage reporting of mosquito swarms and suspected RVF cases Information on RVF for general public, consumer awareness messages Inform trader associations on vaccination and/or sanitary slaughter in affected areas and public health issues.
Coordination	Multi-sectoral technical committee under chair of DVS	Oversee communication messages (ensure consistency of messages from livestock and public health sectors) Oversee mobilization of funds Oversee collaboration between ministries Oversee activities of NGOs Oversee implementation of control strategy Oversee collaboration with trader associations.
	DVS-DVO-DVS	Keep updated on preparations at HQ Issue reminders of policies and strategies to DVOs DVOs keep DVS updated on local situation.
	Local RVF management committees	Continuation Support active searching (flooding, mosquitoes, disease) and community reporting to DVO Implement prevention and control activities Sustained public awareness.
	East African Community, IGAD and COMESA	Coordinate trade issues within RECs.
	RAHC	Coordination of vaccine supply in at-risk countries Activate cross border committees.
Early warning	Not applicable at this stage	
Surveillance	PDS for early outbreak detection	Expand to adjacent districts.
Surveillance (continued)	Active surveillance	Expand to adjacent districts.
	Sero-surveillance	Expand to include adjacent areas with mosquito swarms.
	Animal movement	Intensive monitoring of live animal movements along the main supply chains in surrounding affected areas.
	Definitive laboratory diagnosis	Virus isolation and identification in suspect cases Identification of mosquito species and virus isolation.
Disease control	Vaccination	Do not vaccinate in areas where RVF is suspected or confirmed.
	Supportive treatment	Carry out in areas where vaccination has been eliminated as a strategy.
	Sanitary slaughter	Institute sanitary slaughter in approved facilities.
	Quarantine and movement control	Prevent movement of animals from an infected area to disease-free area to protect national livestock-derived foods market, but this is very unlikely to prevent spread of the outbreak Involve livestock trader association in enforcing quarantine and movement restriction measures Ensure that only properly identified animals enter the supply chain and markets.
Vector control	Insecticide impregnated nets	Move to reassure communities and minimize incidence of malaria: unlikely to have any impact on RVF transmission to people.
	Spray mosquito breeding sites	Spray flooded areas if feasible.
	Insecticides applied to livestock	Apply insecticide to livestock in flooded areas if feasible.
Trade	Export ban	Preventing animals from high-risk area entering export markets.
	Notify OIE	Laboratory confirmation of RVF cases in livestock: Formal notification to OIE of confirmation of RVF by government.
	Notification	Notify trader association that control measures (vaccination, vector control, movement restrictions/bans) have been implemented in affected catchment areas and/or along the supply chain crossing affected areas.
Funding	Emergency RVF funds	Continue to make available in high-risk and adjacent areas Mobilize resources to support trader associations in monitoring main livestock markets and supply chains.
	Donor funds	Activate funding for neighboring/adjacent high-risk areas.
Recovery	RVF emergency funds/insurance	Mobilize emergency funding/self help schemes.
Institutions and policies	Not applicable at this stage	
Research, impact assessment and risk assessment	Proper record keeping	To enable lessons to be learned to improve future prevention and control responses.

*The activities listed under these events are the same - except that the event "Laboratory confirmation of RVF cases in livestock" requires reporting to OIE

TABLE 7
No new human cases for 6 months and no clinical livestock cases for 6 months

Category	Activity	Explanation
Capacity	Assessment	Assess performance of material and human capacity in areas of communication, coordination, risk assessment, surveillance, and disease control Performance of trader associations and cross-border committees.
Communication	Public awareness	Advise communities in epizootic areas that risk of RVF has abated Advise general public that RVF risk has abated Inform trader association that the RVF outbreak has abated.
Coordination	Multi-sectoral technical committee under chair of DVS	Review and document lessons learned from RVF epizootic Review collaboration with trader associations.
Early warning	International RVF early warning systems	Revert to normal practice of monitoring early warning systems.
Surveillance	Range of surveillance tools	Revert to normal inter-epizootic surveillance practices.
Disease control	RVF prevention and control measures	Revert to normal inter-epizootic practices.
Vector control	Not applicable at this stage	
Trade	Update trading partners	Advise trading partners of current RVF disease status.
Funding	Emergency RVF fund	Switch from prevention and control to funding of recovery phase.
Recovery	Needs assessment of affected communities	Assess needs within affected communities and at all stages of livestock value chains and related livelihoods Target available funding to most needy Review performance of insurance, contingency, and self help funds during the out-break.
Institutions and policies	Not applicable at this stage	
Research, impact assessment and risk assessment	Impact assessment	Assess impact of epizootic within affected communities and on local and national economies.
	Lessons learned	Discern lessons learned to inform future prevention and control activities.

TABLE 8
Post-outbreak recovery and reflection

Category	Activity	Explanation
Capacity	Not applicable at this stage	
Communication	Feedback	Disseminate findings of lessons learned to main stakeholders, including trader associations.
Coordination	Multi-sectoral technical committee under chair of DVS	Review and document lessons learned from RVF epizootic.
Early warning	Not applicable at this stage	
Surveillance	Sentinel herds	Placement of new sentinel herds in high-risk areas.
Disease control	RVF prevention and control measures	Revert to normal inter-epizootic practices.
Vector control	Not applicable at this stage	
Trade	Promotion of domestic, regional and international trade	Ensure trading partners are aware of current RVF disease status and carry out confidence building measures to rebuild domestic, regional, and international trade.
Funding	Emergency RVF fund	Switch from prevention and control to funding of recovery phase Replenish emergency funding mechanisms.
Recovery	Credit Grants	Implement recovery activities based on needs assessment and prioritization.
Institutions and policies	Lessons learned	Review lessons learned and consider need for Institutions and policies.
Research, impact assessment and risk assessment	Impact assessment	Finalize and disseminate impact assessment study.
	Lessons learned	Finalize and disseminate lessons learned to inform future prevention and control activities.
	Active sero-surveillance	Determine herd immunity post vaccination.

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Acknowledgment: This decision-support tool has been developed from input, comments, and suggestions provided by a wide range of participants.

An initial workshop was jointly convened by the Food and Agriculture Organization of the United Nations (FAO) and the International Livestock Research Institute (ILRI) and held at ILRI, Nairobi in late March 2008. During that workshop participants generated the initial material, which was then compiled and edited into the first draft of the decision-support tool. The participants who attended that workshop and the organizations to which they are affiliated were:

Name	Job Title and Organization
Bernard Mugenyi	Representative of DVS (Deputy Director DVS), Kenya
Bruno Minjauw	Consultant, FAO Kenya
Chris Jost	Scientist, ILRI
Dickens Chibeu	Epidemiologist, AU-IBAR
Emanuel Senyael	Officer-in-charge, VIC, Arusha, Tanzania
Gabriel Turasha	Country Programme Coordinator, VETAID, Tanzania
Gijs Van't Klooster	FAO-ECU, Ethiopia
Hiver Boussini	Animal Health Officer, AU-IBAR

Continued

TABLE
Continued

<i>Name</i>	<i>Job Title and Organization</i>
<i>Ilona Glöcks</i>	<i>Project Manager Kenya, VSF Suisse</i>
<i>Jeff Mariner</i>	<i>Animal Health and International Trade Team Leader, ILRI</i>
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<i>Joseph Litamoi</i>	<i>Animal Health Expert, FAO, ECTAD-RAHC</i>
<i>Joseph Njuguna</i>	<i>Livestock Consultant, FAO Kenya</i>
<i>Massimo Castiello</i>	<i>Livestock Project Coordinator, FAO Somalia</i>
<i>Mohamed Yussuf</i>	<i>Kenya Emergency Projects Manager, FAO Somalia</i>
<i>Murithi R. Mbabu</i>	<i>Head VEEU, DVS, Kenya</i>
<i>Paul Rwambo</i>	<i>Animal Health Expert, FAO Kenya</i>
<i>Peninah Munyua</i>	<i>Veterinary Officer – Epidemiologist, DVS, Kenya</i>
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<i>Serge Nzietchueng</i>	<i>Consultant, Theme 3 Market Opportunities, ILRI</i>
<i>Simon Kihu</i>	<i>Consultant, ILRI</i>
<i>Keith Sones</i>	<i>Consultant/facilitator, ILRI</i>

The first draft of the decision-support tool was then exposed to critical review by close to 100 participants at the United States Centers for Disease Control's Rift Valley Fever Workshop 2008: Scientific pathways toward public health prevention and response, held in Nairobi in early May 2008. The organizers kindly allocated one workshop session to a discussion focused on the draft decision-support tool during which participants were encouraged to provide feedback and make observations and suggestions for the improvement of the tool. Participants were also invited to provide individual comments by e-mail.

A small group drawn from participants at the initial workshop reviewed the revised document at a meeting held at ILRI in September 2008 and final changes recommended by them have been incorporated into this version.

The tool has been reviewed and approved by the FAO's Emergency Center for Transboundary Animal Diseases (ECTAD) of the Regional Animal Health Center, Nairobi. Individual staff members of ECTAD were also active participants in both the FAO/ILRI and CDC workshops. It has also been reviewed by internal and external reviewers appointed by ILRI.

The map of areas at risk from epizootics of RVF was kindly provided by Assaf Anyamba and the U.S. Department for Defense Global Emerging Infections Surveillance and Response System and NASA Goddard Space Flight Center Rift Valley Fever Monitoring Team.

This version of the tool has been compiled and edited by Keith Sones based on inputs, feedback, suggestions, corrections, and comments received from the many contributors mentioned previously. The valuable and expert contributions of everyone involved in the development and refinement of this participatory and evolving product is gratefully acknowledged.

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ELEMENT 4: SELECTED USEFUL PUBLICATIONS

- Davies FG, Martin V, 2003. Recognizing Rift Valley fever. Rome, Italy: Food and Agriculture Organization of the United Nations. Available at: <http://www.fao.org/DOCREP/006/Y4611E/Y4611E00.HTM>.
- Jost et al., Epidemiological assessment of the Rift Valley fever outbreak in Kenya and Tanzania in 2006 and 2007, being published in this same volume of AJTMH.
- Geering WA, Davies FG, with additions by Martin V, 2002. Preparation of Rift Valley Fever Contingency Plans. FAO Animal Health Manual No. 15. Rome, Italy: Food and Agriculture Organization of the United Nations. Available at: <http://www.fao.org/DOCREP/005/Y4140E/Y4140E00.HTM>.

RESOURCES

- OIE standards for diagnostic tests and vaccines:
http://www.oie.int/eng/normes/mmanual/A_00031.htm
- OIE regulations on import of livestock and livestock products from RVF infected countries:
http://www.oie.int/eng/normes/mcode/en_chapitre_2.2.14.htm
http://www.oie.int/eng/normes/mcode/en_chapitre_2.2.14.htm
- RVF early warning systems:
U.S. Department for Defense Global Emerging Infections Surveillance and Response System (GEIS) see:
<http://www.geis.fhp.osd.mil/GEIS/SurveillanceActivities/RVFWeb/infopages/updateRVF.asp>
- FAO EMPRES:
http://www.fao.org/ag/AGA/AGAH/EMPRES/tadinfo/e_tadRVF.htm
- Vaccine manufacturers:
Onderstepoort Biological Products, South Africa
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